Three hundred and seventh Meeting.

April 4, 1848. — MONTHLY MEETING.

The PRESIDENT in the chair.

Mr. Bond communicated a farther notice respecting the third satellite of Jupiter, as follows: —

"In my communication of the 5th of February, I gave some account of a remarkable change which took place in the appearance of the third satellite of Jupiter, while transiting his disk on the evening of January 28th. I am now enabled, from subsequent observation, to confirm in a more detailed manner the account then given.

"During the evening of March 11th, this satellite was again seen as a *black* spot upon the disk of the primary; but as several visitors were present at the Observatory, the observations were discontinued. It was remarked, however, that the spot was of less magnitude than the shadow which subsequently passed the disk.

"On the 18th of March, we were more fortunate. The state of the atmosphere proving favorable, I watched, with my son, the entire transit. The following are the results of our observations.

"At $8^{h.}$ $15^{m.}$ sidereal time of the Observatory, we commenced, by estimating independently the relative order of brightness of the satellites; it was, — first, third, second, fourth.

"The third satellite, when close to the limb of Jupiter, suffered no diminution of its brightness or apparent magnitude.

"At the first contact with the primary, the latter seemed to recede from the satellite.

"At $8^{h.}$ $51^{m.}$, the contact of the centre of the satellite with the limb of Jupiter took place.

"$8^{h.}$ $55^{m.}$. First internal contact; the satellite was then seen distinctly on the disk, *brighter* than Jupiter, although it had entered on a bright channel between the great belt and a smaller one south of it. The satellite was thought to be less bright on its southern limb.

"At $9^{h.}$ $15^{m.}$, it had decreased in brightness so as to become hardly perceptible.

"At $9^{h.}$ $18^{m.}$ $15^{s.}$, my son, who was now observing, exclaimed quickly, — 'The dark spot is coming on; I now see the satellite; the dark spot is on the right hand, perhaps a little above!' On examination, I found the spot was quite distinct.

" $9^{h.}$ $21^{m.}$. The dark spot increases, and is now seen on the satellite.

" $9^{h.}$ $33^{m.}$. The spot has become conspicuous.

" At $9^{h.}$ $40^{m.}$, the diameter of it was measured with the spider-line micrometer, in the direction of the belts of Jupiter, and was found to be 0.″50 by B_2, immediately after the angle of position of what was considered to be the longer axis = 170°.

" The following diameters were then measured in the first position:—

	h.	m.	″	
At	9	44	0.71	by B_2.
	9	47	0.85	" B_1.
	9	55	1.10	" B_2.
	10	00	1.00	" B_1.
	10	02	0.99	" "

" $10^{h.}$ $5^{m.}$. It appears perfectly black and nearly round; tried different powers; it is best seen with 400; there are doubts of the spot being round, but could not decide on any other form.

" $10^{h.}$ $32^{m.}$ B_1 thinks it is not so black as it was.

" $10^{h.}$ $35^{m.}$. Satellite past the middle, and keeps in the bright channel.

" $11^{h.}$ $7^{m.}$. The satellite now appears black; it has accomplished three quarters of its journey across the disk.

" $11^{h.}$ $17^{m.}$. Spot dark as ever, perhaps darker. B_2 thinks it inclines to the south-following limb of the satellite.

" $11^{h.}$ $37^{m.}$. The satellite is seen broad, but not so dark; it is getting near the edge.

" $11^{h.}$ $52^{m.}$. Can just discern the spot, but the altitude is getting low; however, the seeing is remarkably good, at times, for so low an altitude. It is now doubtful whether the bright part of the satellite can be seen or not.

" $11^{h.}$ 58^{m}. Neither spot nor satellite is visible, absolutely.

" $12^{h.}$ $6^{m.}$. One half the satellite is seen as it passes off the disk; it is *bright*.

" $12^{h.}$ $12^{m.}$. The last external contact was observed by B_2, who noticed that the limb of Jupiter appeared flattened.

" $12^{h.}$ $21^{m.}$. The third satellite is now seen at a considerable distance from Jupiter, and the order of brightness is,— first, second, third. The fourth satellite is under eclipse.

" It is evident that the third satellite is not now one half the brightness of the second, which it far surpassed before the transit took place.

It has also diminished in apparent magnitude, and the light has changed from a strong yellowish-white to a dull bluish-gray color.

" The tabular order of the mean relative magnitudes of the satellites is, — third, fourth, first, second.

" One of the most remarkable features attending the progress of this phenomenon was the rapidity with which the change from bright to dark took place. At $9^{h.}$ $15^{m.}$ there was no indication of change, unless the apparent gradual fading of the light of the satellite is so considered, but which I should rather attribute to the increased amount of light reflected from Jupiter nearer this centre. At $9^{h.}$ $18^{m.}$ $30^{s.}$, when I again saw the satellite, the dark part had so increased as not to be mistaken for a moment, and my son represents the change as taking place almost instantaneously, not leaving a doubt from the first.

" The satellite was watched for some time after the transit, and it appeared to be *gradually* resuming its pristine brilliancy."

Mr. Mitchell read the subjoined account of a remarkable meteor, which was seen from Nantucket, on the 6th of March last.

" On the 7th of last month (March), 1848, while in Boston, I received a letter from my daughter, at Nantucket, stating that on the previous morning, at about half past two o'clock, a meteor of surpassing magnitude and brilliancy was seen by several persons, and its report was so loud that many individuals were awakened by it. With a view of eliciting information from other quarters, I requested the editor of the Evening Transcript to give publicity to the fact, simply as I have now stated it.

" On returning to Nantucket, so much was said of the magnitude and extreme brightness of the meteor, and of the loudness of the report, that I was induced to make a systematic investigation of the circumstances attending it, in view of the possibility that some of the fragments, or the undivided body itself, might have fallen upon the island.

" Among the witnesses of the phenomenon were two of the street watchmen, both intelligent men, who were situated, at the moment, 3,250 feet asunder, and in a direction from each other nearly at right angles with the direction of the meteor as first seen. With each of these gentlemen I went to the spot which they respectively occupied when they first saw it, and by the aid of buildings in the vicinity I

was able to ascertain, to tolerable satisfaction, the apparent direction of its motion, and its position when earliest seen. Taking afterwards, by means of a circumferenter, the difference of its apparent position at these extreme points, and assuming that the eyes of both observers were directed to it at the same moment, which is the more likely to be true, from the fact, that they were both facing the region occupied by the meteor, I found its parallax with this base to be 6° ; its direction from one being south $52\frac{1}{2}$° east, and from the other south $46\frac{1}{2}$° east, each at an estimated altitude of 30°.

" The report occurred ninety-two seconds after the entire extinction of the illumination, and after the meteor, without any appearance of separation, had reached the horizon.

" To obtain the measurement of this interval, I requested each watchman separately, and without the knowledge of the other, to move onward in his usual pace to the position at which he had arrived when the report was heard, and during this period, I noted the time by a chronometer ; and it is certainly remarkable, that by this rude method they differed from each other less than five seconds.

" All parties agree that the illumination was quite equal to that of a bright moon, giving to every visible object a frightful aspect ; and also that the brilliancy of the meteor was extremely painful to the eye. Only two persons with whom I have conversed were so situated as to follow its course quite to the horizon, or near to the point of its contact with the earth. Those individuals testify, that it emitted no scintillations, but maintained a perfectly circular form through its whole course. The report is said to have been startling ; the rattling of windows and jarring of the houses are spoken of by many witnesses, every one noticing that, unlike the discharge of cannon or a peal of thunder, it was without reverberation. Some persons who were roused by the extreme light, but did not see the illumination, supposed it to have been the jar of an earthquake.

" Observers differ widely in estimating its apparent diameter, though they were requested to observe the moon as the standard of measurement. Some supposed it exceeded the moon ; others, and quite the greatest number, thought it less than the moon in apparent diameter, the lowest estimate being two thirds the disk of that luminary. I take twenty minutes to be the optical apparent diameter of the meteor ; stripping this of all possible illusion arising from its dazzling brightness, I am persuaded that it subtended an angle of at least twelve minutes.

"From these data, rude and imperfect as they necessarily are, I conclude that a mass of matter nearly spherical, one hundred and five feet in diameter, entered the earth's atmosphere in a direction from west to east, passed the town of Nantucket, with great obliquity, at the distance of nearly 6 miles, and impinged upon the earth's surface $19\frac{3}{4}$ miles east of the town, in the Atlantic ocean, 14 miles east of the island.

"Whether this mass was solid or fluid is uncertain; and yet we can hardly suppose that a gaseous body, when rushing through the atmosphere, would have maintained so constantly its globular form, as indicated by its circular appearance; nor are we prepared to admit, that one liquid mass impinging on another would produce a report, which, at the distance of twenty miles, would be so sharp and jarring, that many persons should think it an earthquake. My own opinion is, formed from evidence of which the foregoing is a mere brief, that a solid mass of matter, of no inconsiderable size, fell upon the earth on that occasion."

Professor Peirce communicated the following letter from Mr. Sears C. Walker to himself.

"*Washington, D. C., March 6th*, 1848.

"I have computed the small corrections of the elliptic elements of the planet Neptune, which you were so kind as to communicate to the American Academy in December last.

$$
\begin{aligned}
d\pi &= -1^\circ\ 8'\ 56''.43.\\
d\Omega &= -\ 14.22.\\
d\,i &= -\ 0.57.\\
d\,e &= +0.000014205.\\
d\mu &= 0''.0.\\
d\,M &= +47''.84.\\
d\,T &= 0.0^{\text{y}}.
\end{aligned}
$$

These corrections, applied to the first approximation, furnish the second approximation towards the elliptic elements of Neptune.

$$
\left.\begin{aligned}
\pi &= 47^\circ\ 12'\ 6''.50\\
\Omega &= 130\ \ 4\ \ 20.81
\end{aligned}\right\}\text{ mean equinox, Jan. 1, 1847.}
$$

$$
\begin{aligned}
i &= 1\ \ 46\ \ 58.97.\\
e &= 0.00871946.\\
\mu &= 21.''55448.\\
M &= 328^\circ\ 32'\ 44''.20, \text{ mean noon, Greenwich, Jan. 1, 1847.}\\
T &= 164.6181 \text{ tropical years.}
\end{aligned}
$$

" The ephemeris from these elements II., after applying the values of the perturbations δv and δr, from your paper of Dec. 17th, 1847, before referred to, requires, in order to conform to observation, the following corrections in R. A. and Dec.

	Obs. — Eph. $\Delta A_{\prime}$	Obs. — Eph. $\Delta D_{\prime}$
1795, May 8,	$+ 0''.29$	$+ 0''.79$
" " 10,	$+ 1.18$	$+ 0.31$
1846, Sept. 26,	$- 0.21$	$+ 0.55$
" Nov. 7,	$- 0.10$	$+ 0.63$
1847, April 6,	$+ 0.42$	$- 0.18$
" Aug. 22,	$- 0.66$	$+ 0.23$
" Nov. 14,	$- 0.70$	$+ 0.90$

The agreement is so close, that I shall not attempt any farther approximation towards the true elements till after the next opposition has been observed. For the Lalande observations, I have used Mauvais's places from the *Comtes Rendus.* They furnish internal evidence of their excellence, by their perfect representation of the two days' motion of the planet.

" Yours, truly and respectfully,

" SEARS C. WALKER."

Professor Peirce communicated a memoir from Mr. G. P. Bond, on the direct computation of the orbit of a comet, from three observations of its right ascension and declination, and remarked upon the clear and simple views which Mr. Bond had taken of the subject.

Professor Peirce announced that he had completed his investigation into the action of Neptune upon Uranus, and had ascertained that this planet will completely account for the observed irregularities in the motions of Uranus, provided that mass of Neptune is adopted which is derived from Mr. Bond's observations of Lassell's satellite.

" The following table exhibits the residual differences between the observed and computed longitudes of Uranus, from which it appears that, with the mass of Neptune deduced from Mr. Bond's observations of Lassell's satellite, the theory of Uranus is now perfect, and the motions of this planet do not indicate that there is any other unknown source of perturbation. It appears, moreover, that the mass which is

derived from Mr. Bond's observations is far more satisfactory than that which M. Struve has obtained from his own observations.

"The fifth and sixth columns of the table contain the small discrepancies between theory and observation which would have remained after making allowance for the action of the hypothetical planets of Adams and Leverrier; and their comparison with the second column shows that the observation of 1690 was not sufficiently well represented by the theories which resulted in the discovery of Neptune.

"The seventh column contains the residual defects of the best theory of Uranus, which is independent of the action of an external planet, and is the true basis of the researches of Adams and Leverrier. This theory was constructed by Leverrier from all the modern observations, and the discrepancy between theory and observation was the final proof that Uranus was subjected to some unknown cause of perturbation. The time t is the number of Julian years from Jan. 1, 1850. The longitude of the perihelion is denoted by ϖ, with the symbol of the planet subjacent.

"*Residual Differences between the Theoretical and Observed Longitudes of Uranus, from the Theories of Peirce, Leverrier, and Adams.*

Date.	From Peirce's Theory of Neptune, adopting for its mass, — that deduced by Peirce from Bond's observations of Lassell's satellite $= \frac{1}{19840}$	that deduced by Peirce from Bond's and Lassell's observations combined $= \frac{1}{18780}$	that deduced by Struve from his own observations of the satellite $= \frac{1}{14496}$	From Leverrier's original theory, with his best orbit of hypothetical planet, of which the mass $= \frac{1}{9322}$	From Adams's original theory, with his 2d hypothetical planet, of which the mass $= \frac{1}{6666}$	From Leverrier's best orbit of Uranus for the modern observations, without any external planet.
1845	−0.″9	−1.″2	−2.″8	−0.″3		+6.″5
1840	−1.1	−1.3	−1.3	+2.2	+1.″3	+0.7
1835	+2.0	+2.4	+3.9	−0.8	−1.2	−4.5
1829	+0.8	+1.3	+2.5	−2.2	+2.0	−7.8
1824	−2.0	−1.9	−1.6	−5.4	+1.7	−7.6
1819	+1.0	+0.7	+0.9	+0.4	−2.2	+3.8
1813	−0.3	+1.1	−2.3	−0.9	−1.0	+4.5
1808	−0.4	−0.6	−1.3	+0.8	0.0	+3.8
1803	+0.8	+1.2	+3.2	+0.8	+1.6	−3.4
1797	+0.3	+0.8	+3.3	−1.0	−0.5	−6.7
1792	+0.3	+0.5	+1.6	+0.3	−1.1	−7.8
1787	−0.5	−1.2	−4.7	−1.2	−0.2	+2.0
1782	−3.0	−5.6	−18.3	+2.3	0.0	+20.5
Ancient. 1769	−6.0	−16.0	−67.0	+3.7	+1.8	+123.3
Ancient. 1756	+4.0	−12.7	−102.4	−4.0	−4.0	+230.9
Ancient. 1715	+8.7	+10.0	−99.6	+5.5	−6.6	+279.6
Ancient. 1690	+0.8	+13.0	−124.7	−19.9	+50.0	+289.0

"This table was computed from the following formulæ for the perturbations of the mean longitude and radius vector of Uranus, which are arranged in a form similar to that proposed by Leverrier, and adopted in his theory of Mercury. The mean longitude of each planet is denoted by the appropriate symbol of the planet. The elements of Neptune which are adopted are those last given by Mr. Walker, and the mass of Neptune which is introduced into the formulæ is $\frac{1}{20000}$th of the sun's mass, for which any other mass is readily substituted by simple multiplication.

"The perturbation of the mean longitude $= \delta v =$

$$
\begin{array}{llll}
- 33''82 \text{ sin. } (♅ - ♆) & - 0''02 \text{ cos. } (♅ - ♆) \\
- 818.98 \text{ sin. } 2(♅ - ♆) & - 0.99 \text{ cos. } 2(♅ - ♆) \\
+ 14.10 \text{ sin. } 3(♅ - ♆) & - 0.01 \text{ cos. } 3(♅ - ♆) \\
+ 3.93 \text{ sin. } 4(♅ - ♆) & + 0.18 \text{ cos. } 4(♅ - ♆) \\
+ 1.05 \text{ sin. } 5(♅ - ♆) & - 0.01 \text{ cos. } 5(♅ - ♆) \\
+ 0.43 \text{ sin. } 6(♅ - ♆) & + 0.20 \text{ sin. } 7(♅ - ♆) \\
+ 0.09 \text{ sin. } 8(♅ - ♆) & + 0.04 \text{ sin. } 9(♅ - ♆) \\
+ 0.02 \text{ sin. } 10(♅ - ♆) & + 0.01 \text{ sin. } 11(♅ - ♆) \\
+ 0.01 \text{ sin. } 12(♅ - ♆) & + A
\end{array}
$$

$$
\begin{array}{l}
+ 0''00434\, t \text{ sin. } (♅ - \varpi_{♅}) - 0''035411\, t \text{ cos. } (♅ - \varpi_{♅}) \\
+ k \text{ sin. } (♅ + \theta - \varpi_{♅}) \\
+ k_1 \text{ sin. } (2\,♅ + \theta_1 - 2\,\varpi_{♅}) \\
+ k_2 \text{ sin. } (♅ + \theta_2 - \varpi_{♅})
\end{array}
$$

in which

$$
\begin{array}{lll}
A = & 2692''74 \text{ sin. } (2\,♆ - ♅ - \varpi_{♅}) & + 149''76 \text{ cos. } (2\,♆ - ♅ - \varpi_{♅}) \\
+ & 106.80 \text{ sin. } (4\,♆ - 2\,♅ - 2\,\varpi_{♅}) & - 43.08 \text{ cos. } (4\,♆ - 2\,♅ - 2\,\varpi_{♅}) \\
- & 6.09 \text{ sin. } (6\,♆ - 3\,♅ - 3\,\varpi_{♅}) & + 4.20 \text{ cos. } (6\,♆ - 3\,♅ - 3\,\varpi_{♅}) \\
+ & 0.48 \text{ sin. } (8\,♆ - 4\,♅ - 4\,\varpi_{♅}) & + 0.47 \text{ cos. } (8\,♆ - 4\,♅ - 4\,\varpi_{♅}) \\
- & 0.06 \text{ sin. } (10\,♆ - 5\,♅ - 5\,\varpi_{♅}) & + 0.01 \text{ cos. } (10\,♆ - 5\,♅ - 5\,\varpi_{♅})
\end{array}
$$

$$
\begin{array}{lll}
k \text{ sin. } \theta = & - 2''58 \text{ sin. } (♅ - ♆) & - 0''44 \text{ cos. } (♅ - ♆) \\
& - 11.35 \text{ sin. } 2(♅ - ♆) & - 0.02 \text{ cos. } 2(♅ - ♆) \\
& + 18.27 \text{ sin. } 3(♅ - ♆) & + 3.68 \text{ cos. } 3(♅ - ♆) \\
& + 66.38 \text{ sin. } 4(♅ - ♆) & + 13.50 \text{ cos. } 4(♅ - ♆) \\
& - 2.74 \text{ sin. } 5(♅ - ♆) & - 0.56 \text{ cos. } 5(♅ - ♆) \\
& - 0.78 \text{ sin. } 6(♅ - ♆) & - 0.17 \text{ cos. } 6(♅ - ♆) \\
& - 0.26 \text{ sin. } 7(♅ - ♆) & - 0.05 \text{ cos. } 7(♅ - ♆)
\end{array}
$$

$$
\begin{aligned}
&- 0''.10 \text{ sin. } 8(\text{♅}-\text{♆}) - 0''.03 \text{ cos. } 8(\text{♅}-\text{♆})\\
&- 0.04 \text{ sin. } 9(\text{♅}-\text{♆}) - 0.01 \text{ cos. } 9(\text{♅}-\text{♆})\\
&- 0.02 \text{ sin. } 10(\text{♅}-\text{♆}) - 0.01 \text{ cos. } 10(\text{♅}-\text{♆})\\
&- 0.02 \text{ sin. } 11(\text{♅}-\text{♆}) - 0.01 \text{ cos. } 11(\text{♅}-\text{♆})\\
&- 0.01 \text{ sin. } 12(\text{♅}-\text{♆}) - 0.01 \text{ sin. } 13(\text{♅}-\text{♆})
\end{aligned}
$$

$$
\begin{aligned}
k \text{ cos. } \theta = &- 0''.42 \text{ sin. } (\text{♅}-\text{♆}) + 1''.44 \text{ cos. } (\text{♅}-\text{♆})\\
&+ 0.02 \text{ sin. } 2(\text{♅}-\text{♆}) - 11.35 \text{ cos. } 2(\text{♅}-\text{♆})\\
&+ 3.68 \text{ sin. } 3(\text{♅}-\text{♆}) - 17.71 \text{ cos. } 3(\text{♅}-\text{♆})\\
&+ 13.42 \text{ sin. } 4(\text{♅}-\text{♆}) - 66.18 \text{ cos. } 4(\text{♅}-\text{♆})\\
&- 0.56 \text{ sin. } 5(\text{♅}-\text{♆}) + 2.84 \text{ cos. } 5(\text{♅}-\text{♆})\\
&- 0.17 \text{ sin. } 6(\text{♅}-\text{♆}) + 0.82 \text{ cos. } 6(\text{♅}-\text{♆})\\
&- 0.05 \text{ sin. } 7(\text{♅}-\text{♆}) + 0.28 \text{ cos. } 7(\text{♅}-\text{♆})\\
&- 0.03 \text{ sin. } 8(\text{♅}-\text{♆}) + 0.13 \text{ cos. } 8(\text{♅}-\text{♆})\\
&- 0.01 \text{ sin. } 9(\text{♅}-\text{♆}) + 0.06 \text{ cos. } 9(\text{♅}-\text{♆})\\
&- 0.01 \text{ sin. } 10(\text{♅}-\text{♆}) + 0.04 \text{ cos. } 10(\text{♅}-\text{♆})\\
&- 0.01 \text{ sin. } 11(\text{♅}-\text{♆}) + 0.02 \text{ cos. } 11(\text{♅}-\text{♆})\\
&+ 0.01 \text{ cos. } 12(\text{♅}-\text{♆}) + 0.01 \text{ cos. } 13(\text{♅}-\text{♆})
\end{aligned}
$$

$$
\begin{aligned}
k_1 \text{ sin. } \theta_1 = &+ 0''.41 \text{ sin. } 2(\text{♅}-\text{♆}) - 0''.65 \text{ cos. } 2(\text{♅}-\text{♆})\\
&- 0.49 \text{ sin. } 3(\text{♅}-\text{♆}) - 0.13 \text{ cos. } 3(\text{♅}-\text{♆})\\
&- 1.07 \text{ sin. } 5(\text{♅}-\text{♆}) - 0.48 \text{ cos. } 5(\text{♅}-\text{♆})\\
&- 5.81 \text{ sin. } 6(\text{♅}-\text{♆}) - 2.50 \text{ cos. } 6(\text{♅}-\text{♆})\\
&- 0.10 \text{ sin. } 7(\text{♅}-\text{♆}) - 0.06 \text{ cos. } 7(\text{♅}-\text{♆})\\
&- 0.06 \text{ sin. } 8(\text{♅}-\text{♆}) - 0.03 \text{ cos. } 8(\text{♅}-\text{♆})\\
&- 0.03 \text{ sin. } 9(\text{♅}-\text{♆}) - 0.02 \text{ cos. } 9(\text{♅}-\text{♆})\\
&- 0.01 \text{ sin. } 10(\text{♅}-\text{♆}) - 0.01 \text{ cos. } 10(\text{♅}-\text{♆})\\
&- 0.01 \text{ sin. } 11(\text{♅}-\text{♆})
\end{aligned}
$$

$$
\begin{aligned}
k_1 \text{ cos. } \theta_1 = &- 0''.65 \text{ sin. } 2(\text{♅}-\text{♆}) - 0''.86 \text{ cos. } 2(\text{♅}-\text{♆})\\
&- 0.13 \text{ sin. } 3(\text{♅}-\text{♆}) + 0.49 \text{ cos. } 3(\text{♅}-\text{♆})\\
&- 0.48 \text{ sin. } 5(\text{♅}-\text{♆}) + 1.07 \text{ cos. } 5(\text{♅}-\text{♆})\\
&- 2.50 \text{ sin. } 6(\text{♅}-\text{♆}) + 5.81 \text{ cos. } 6(\text{♅}-\text{♆})\\
&- 0.06 \text{ sin. } 7(\text{♅}-\text{♆}) + 0.10 \text{ cos. } 7(\text{♅}-\text{♆})\\
&- 0.03 \text{ sin. } 8(\text{♅}-\text{♆}) + 0.06 \text{ cos. } 8(\text{♅}-\text{♆})\\
&- 0.02 \text{ sin. } 9(\text{♅}-\text{♆}) + 0.03 \text{ cos. } 9(\text{♅}-\text{♆})\\
&- 0.01 \text{ sin. } 10(\text{♅}-\text{♆}) + 0.01 \text{ cos. } 10(\text{♅}-\text{♆})\\
&+ 0.01 \text{ cos. } 11(\text{♅}-\text{♆})
\end{aligned}
$$

$$
\begin{aligned}
k_2 \sin.\theta_2 = &+ 0''.71 \sin.\ (4\,\text{♆} - 2\,\text{♅} - 2\,\varpi_{\text{♅}}) - 0''.01 \cos.\ (4\,\text{♆} - 2\,\text{♅} - 2\,\varpi_{\text{♅}}) \\
&+ 0.38 \sin.\ (8\,\text{♆} - 4\,\text{♅} - 4\,\varpi_{\text{♅}}) + 0.54 \cos.\ (8\,\text{♆} - 4\,\text{♅} - 4\,\varpi_{\text{♅}}) \\
&- 0.03 \sin.\ (10\,\text{♆} - 5\,\text{♅} - 5\,\varpi_{\text{♅}}) - 0.06 \cos.\ (10\,\text{♆} - 5\,\text{♅} - 5\,\varpi_{\text{♅}})
\end{aligned}
$$

$$
\begin{aligned}
k_2 \cos.\theta_2 = &+ 0''.01 \sin.\ (4\,\text{♆} - 2\,\text{♅} - 2\,\varpi_{\text{♅}}) + 0''.71 \cos.\ (4\,\text{♆} - 2\,\text{♅} - 2\,\varpi_{\text{♅}}) \\
&- 0.54 \sin.\ (8\,\text{♆} - 4\,\text{♅} - 4\,\varpi_{\text{♅}}) + 0.38 \cos.\ (8\,\text{♆} - 4\,\text{♅} - 4\,\varpi_{\text{♅}}) \\
&+ 0.06 \sin.\ (10\,\text{♆} - 5\,\text{♅} - 5\,\varpi_{\text{♅}}) - 0.03 \cos.\ (10\,\text{♆} - 5\,\text{♅} - 5\,\varpi_{\text{♅}})
\end{aligned}
$$

The perturbation of the radius vector $= \delta r =$

$$
\begin{aligned}
&0.000851 \cos.\ (\text{♅} - \text{♆}) \\
&+ 0.031823 \cos.\ 2\,(\text{♅} - \text{♆}) - 0.000036 \sin.\ 2\,(\text{♅} - \text{♆}) \\
&- 0.000825 \cos.\ 3\,(\text{♅} - \text{♆}) \\
&- 0.000338 \cos.\ 4\,(\text{♅} - \text{♆}) + 0.000026 \sin.\ 4\,(\text{♅} - \text{♆}) \\
&- 0.000069 \cos.\ 5\,(\text{♅} - \text{♆}) - 0.000029 \cos.\ 6\,(\text{♅} - \text{♆}) \\
&- 0.000013 \cos.\ 7\,(\text{♅} - \text{♆}) - 0.000007 \cos.\ 8\,(\text{♅} - \text{♆}) \\
&- 0.000003 \cos.\ 9\,(\text{♅} - \text{♆}) - 0.000002 \cos.\ 10\,(\text{♅} - \text{♆}) \\
&- 0.000001 \cos.\ 11\,(\text{♅} - \text{♆}) - 0.000001 \cos.\ 12\,(\text{♅} - \text{♆}) \\
&- 0.000001565\, t \sin.\ (\text{♅} - \text{♆}) \\
&- 0.000000114\, t \cos.\ (\text{♅} - \text{♆}) \\
&+ B - 0.000232 \\
&+ k' \cos.\ (\text{♅} - \theta' - \varpi_{\text{♅}}) \\
&+ k'_1 \cos.\ (2\,\text{♅} - \theta'_1 - 2\,\varpi_{\text{♅}}) \\
&+ k'_2 \cos.\ (\text{♅} - \theta'_2 - \varpi_{\text{♅}})
\end{aligned}
$$

in which

$$
\begin{aligned}
B = &+ 0.000195 \sin.\ (2\,\text{♆} - \text{♅} - \varpi_{\text{♅}}) \quad + 0.001684 \cos.\ (2\,\text{♆} - \text{♅} - \varpi_{\text{♅}}) \\
&- 0.000089 \sin.\ (4\,\text{♆} - 2\,\text{♅} - 2\,\varpi_{\text{♅}}) - 0.000151 \cos.\ (4\,\text{♆} - 2\,\text{♅} - 2\,\varpi_{\text{♅}}) \\
&+ 0.000012 \sin.\ (6\,\text{♆} - 3\,\text{♅} - 3\,\varpi_{\text{♅}}) + 0.000013 \cos.\ (6\,\text{♆} - 3\,\text{♅} - 3\,\varpi_{\text{♅}}) \\
&- 0.000002 \sin.\ (8\,\text{♆} - 4\,\text{♅} - 4\,\varpi_{\text{♅}}) - 0.000003 \cos.\ (8\,\text{♆} - 4\,\text{♅} - 4\,\varpi_{\text{♅}})
\end{aligned}
$$

$$
\begin{aligned}
k' \cos.\theta' = &+ 0.000009 \sin.\ (\text{♅} - \text{♆}) \quad - 0.000039 \cos.\ (\text{♅} - \text{♆}) \\
&+ 0.000096 \sin.\ 3\,(\text{♅} - \text{♆}) - 0.000477 \cos.\ 3\,(\text{♅} - \text{♆}) \\
&- 0.000001 \sin.\ 4\,(\text{♅} - \text{♆}) - 0.000012 \cos.\ 4\,(\text{♅} - \text{♆}) \\
&- 0.000033 \sin.\ 5\,(\text{♅} - \text{♆}) + 0.000158 \cos.\ 5\,(\text{♅} - \text{♆}) \\
&- 0.000014 \sin.\ 6\,(\text{♅} - \text{♆}) + 0.000047 \cos.\ 6\,(\text{♅} - \text{♆}) \\
&- 0.000004 \sin.\ 7\,(\text{♅} - \text{♆}) + 0.000018 \cos.\ 7\,(\text{♅} - \text{♆}) \\
&- 0.000002 \sin.\ 8\,(\text{♅} - \text{♆}) + 0.000009 \cos.\ 8\,(\text{♅} - \text{♆}) \\
&- 0.000001 \sin.\ 9\,(\text{♅} - \text{♆}) + 0.000003 \cos.\ 9\,(\text{♅} - \text{♆}) \\
&- 0.000001 \sin.\ 10\,(\text{♅} - \text{♆}) + 0.000002 \cos.\ 10\,(\text{♅} - \text{♆}) \\
&+ 0.000001 \cos.\ 11\,(\text{♅} - \text{♆}) + 0.000001 \cos.\ 12\,(\text{♅} - \text{♆})
\end{aligned}
$$

$$
\begin{aligned}
k' \sin.\theta' = & -0.000219 \sin.(♅-⯉) -0.000011 \cos.(♅-⯉) \\
& -0.000399 \sin.\ 3(♅-⯉) -0.000096 \cos.\ 3(♅-⯉) \\
& +0.000012 \sin.\ 4(♅-⯉) -0.000001 \cos.\ 4(♅-⯉) \\
& +0.000170 \sin.\ 5(♅-⯉) +0.000033 \cos.\ 5(♅-⯉) \\
& +0.000053 \sin.\ 6(♅-⯉) +0.000014 \cos.\ 6(♅-⯉) \\
& +0.000022 \sin.\ 7(♅-⯉) +0.000004 \cos.\ 7(♅-⯉) \\
& +0.000011 \sin.\ 8(♅-⯉) +0.000002 \cos.\ 8(♅-⯉) \\
& +0.000005 \sin.\ 9(♅-⯉) +0.000001 \cos.\ 9(♅-⯉) \\
& +0.000002 \sin.\ 10(♅-⯉) +0.000001 \cos.\ 10(♅-⯉) \\
& +0.000001 \sin.\ 11(♅-⯉) +0.000001 \sin.\ 12(♅-⯉)
\end{aligned}
$$

$$
\begin{aligned}
k'_1 \cos.\theta'_1 = & -0.000002 \sin.\ 3(♅-⯉) -0.000001 \cos.\ 3(♅-⯉) \\
& -0.000009 \sin.\ 5(♅-⯉) +0.000027 \cos.\ 5(♅-⯉) \\
& -0.000005 \sin.\ 7(♅-⯉) +0.000012 \cos.\ 7(♅-⯉) \\
& -0.000002 \sin.\ 9(♅-⯉) +0.000006 \cos.\ 9(♅-⯉) \\
& -0.000001 \sin.\ 10(♅-⯉) +0.000004 \cos.\ 10(♅-⯉) \\
& \qquad +0.000003 \cos.\ 11(♅-⯉) \\
& +0.000001 \sin.(2⯉-♅-\varpi_{♅}) +0.001854 \cos.(2⯉-♅-\varpi_{♅}) \\
& \qquad -0.000009 \cos.(4⯉-2♅-2\varpi_{♅}) \\
& -0.000004 \sin.(8⯉-4♅-4\varpi_{♅}) +0.000009 \cos.(8⯉-4♅-4\varpi_{♅})
\end{aligned}
$$

$$
\begin{aligned}
k'_1 \sin.\theta'_1 = & +0.000001 \sin.\ 3(♅-⯉) -0.000002 \cos.\ 3(♅-⯉) \\
& +0.000027 \sin.\ 5(♅-⯉) +0.000009 \cos.\ 5(♅-⯉) \\
& +0.000012 \sin.\ 7(♅-⯉) +0.000005 \cos.\ 7(♅-⯉) \\
& +0.000006 \sin.\ 9(♅-⯉) +0.000002 \cos.\ 9(♅-⯉) \\
& +0.000004 \sin.10(♅-⯉) +0.000001 \cos.\ 10(♅-⯉) \\
& +0.000003 \sin.11(♅-⯉) \\
& +0.001324 \sin.(2⯉-♅-\varpi_{♅}) +0.000027 \cos.(2⯉-♅-\varpi_{♅}) \\
& +0.000009 \sin.(4⯉-2♅-2\varpi_{♅}) \\
& +0.000009 \sin.(8⯉-4♅-4\varpi_{♅}) +0.000004 \cos.(8⯉-4♅-4\varpi_{♅})
\end{aligned}
$$

$$
\begin{aligned}
k'_2 \cos.\theta'_2 = & +0.000253 \sin.(2⯉-♅-\varpi_{♅}) +0.005710 \cos.(2⯉-♅-\varpi_{♅}) \\
& -0.000660 \sin.(4⯉-2♅-2\varpi_{♅}) -0.002992 \cos.(4⯉-2♅-2\varpi_{♅}) \\
& +0.000105 \sin.(6⯉-3♅-3\varpi_{♅}) +0.000282 \cos.(6⯉-3♅-3\varpi_{♅}) \\
& -0.000017 \sin.(8⯉-4♅-4\varpi_{♅}) -0.000025 \cos.(8⯉-4♅-4\varpi_{♅}) \\
& +0.000002 \sin.(10⯉-5♅-5\varpi_{♅}) +0.000003 \cos.(10⯉-5♅-5\varpi_{♅})
\end{aligned}
$$

$$
\begin{aligned}
k'_2 \sin.\theta'_2 = & -0.005710 \sin.(2⯉-♅-\varpi_{♅}) +0.000253 \cos.(2⯉-♅-\varpi_{♅}) \\
& -0.002520 \sin.(4⯉-2♅-2\varpi_{♅}) +0.000558 \cos.(4⯉-2♅-2\varpi_{♅}) \\
& +0.000254 \sin.(6⯉-3♅-3\varpi_{♅}) -0.000085 \cos.(6⯉-3♅-3\varpi_{♅}) \\
& -0.000025 \sin.(8⯉-4♅-4\varpi_{♅}) +0.000017 \cos.(8⯉-4♅-4\varpi_{♅}) \\
& +0.000003 \sin.(10⯉-5♅-5\varpi_{♅}) -0.000002 \cos.(10⯉-5♅-5\varpi_{♅})
\end{aligned}
$$

Mr. Pierce remarked that his original views were unchanged in regard to the importance to be attached to the vast discrepancies between the predicted and observed orbits of the planet which disturbs the motions of Uranus.

" Neptune is not the planet designated by geometry, although it is a perfect solution of the problem which analysis had undertaken to investigate, and had really solved, but in a form radically different from the actual solution of nature. This is not a personal question; it is certainly not one in which the reputations of Adams and Leverrier are concerned. The accuracy of their investigations is not assailed; but it is expressly admitted that they announced the correct results of most profound analytical researches.

" The fair consideration of this question cannot be made without recalling the true office and position of geometry in science, which alone entitles it to the appellation of the key to the physical world. Mathematics is the science of exact measurement; accuracy is its sole aim and object, and it is this which places it in harmony with a creation, which is subject to perfect law and undeviating order. An inaccurate result cannot be a geometrical one; a result, inaccurate beyond certain well-defined limits, does not belong to the exact science; an inconsistency, which exceeds a certain amount, may not be neglected by him who deals with nothing but *more or less*, without disturbing the very foundations of his faith.

" The geometrical statement was distinctly made, that the planet which disturbed Uranus could not be at a less mean distance from the sun than thirty-five times the earth's mean distance from the sun; that is, that no planet which was within this distance could cause the observed irregularities in the motions of Uranus. Neptune's mean distance from the sun is only thirty times the earth's mean distance, and yet Neptune does account for the perturbations of Uranus. It is five hundred millions of miles nearer the sun than it was distinctly stated by geometry that it possibly could be, in order to be capable of producing the effect which it actually does produce. The spirit of mathematical accuracy cannot be supposed to be sufficiently elastic to embrace so great an inconsistency, amounting to one sixth part of Neptune's distance from the sun, and to one half of the distance of his orbit from that of Uranus.

" Whence comes this enormous difference between the theoretical

and observed planets? Had it been quite small, it might have been regarded as an excusable numerical error. Had it even amounted to once or twice the radius of the earth's orbit, it might have been deemed an error, although it would then have been a grievous one, and would have seriously marred the beauty of the result. But as it is, it cannot be assumed to be a mere error, without admitting that such an one radically vitiates the whole theory. Whoever adopts this opinion, be it the author of the theory himself, is bound to show where the error is, and how far it extends. Such an opinion has never been advanced by me, and I am not responsible for it. I admit, however, that I have not fully investigated this point, but maintain that the profound geömetry of M. Leverrier is not to be set aside without proof, or even argument. M. Leverrier found that the planet which would best account for the disturbed motion of Uranus was at the mean distance 36 from the sun; and that, by increasing or decreasing the mean distance of the hypothetical disturber, the want of coincidence between the observed and computed motions of Uranus increased until, at the mean distances of 38 on the increase and 35 on the decrease, the residual differences between theory and observation became so great as to be wholly inadmissible. He therefore came to the natural conclusion, from such a result, that the mean distance of the required planet from the sun could not be less than 35, or more than 38; and he contented himself with this conclusion, without extending his inquiries to still smaller mean distances; and any facts in regard to these inner distances which are *at variance with this result* are certainly not to be included under his theory. I have confined my remarks to M. Leverrier's researches, but nothing in Mr. Adams's less comprehensive investigations, in which there is no attempt to ascertain the limits, is opposed to these conclusions.

"It has been intimated, that too rigorous an agreement with observation was insisted upon in the original inquiries, and that the limits might have been extended to include Neptune, by a more liberal concession to other unknown planets, or to an error in the mass of Saturn. The inspection of the preceding table completely refutes such a suggestion, for it now appears that Neptune satisfies the observations of Uranus more perfectly than the best planet of previous theory. If Leverrier was, as I have supposed, correct in his former computations, he must have found by extending them, that, although the action of his hypothetical planet agreed less perfectly with observation by the

contraction of the radius of its orbit from 36 to 35, and that this disagreement would have still farther increased by a still farther contraction, there was a distance at which the disagreement ceased to increase, and would, on the contrary, begin to diminish, until at the distance 30 it would have vanished, and the disturbed motions of Uranus would have been wholly explained. But this singular change in the character of the disturbing force, if it really occurs, — and the only doubt in regard to it is derived from a supposed but unproved inaccuracy in Leverrier's investigations, — was excluded from the range of this geometer's investigations, and now that observation has led to its discovery, geometry cannot claim it as one of its predictions. The defect of the theory must be as frankly admitted as the more serious charge of error is boldly repelled.

" From some indistinct remarks which have been thrown out in regard to the mass of Neptune, which is not too small to be excluded from the limits of the theory, there seems to be an indisposition to confess this defect. But on turning to the original formulæ, it will be found that, although this small mass is not positively excluded, its adoption does not contribute to advance the claim of geometry upon the planet. It shows, on the contrary, most decisively, that the orbits of theory are all of them fundamentally different from those of Neptune. For the mean distance which corresponds to this mass in the theory is about $35\frac{1}{2}$, and the eccentricity very much greater than in the best hypothetical orbit, while the discrepancy between the theoretical and observed action on Uranus is increased beyond the admitted limits.

" The case might safely rest there, but I desire to dwell upon the essential and radical difference between Neptune's action upon Uranus and that of the planets of theory. For this purpose, I will read an extract from a report made by me last September to the honorable committee of the Overseers of Harvard University who visited the Observatory.

" 'The differences are not accidental, but inherent in the very nature of the case, while the points of resemblance are purely accidental. The solutions of Adams and Leverrier are perfectly correct for the assumption to which they are limited, and must be classed with the boldest and most brilliant attempts at analytical investigation, richly entitling their authors to all the *éclat* which has been lavished upon them, on account of the singular success with which they are thought to have been crowned. But their investigations are nevertheless wholly inap-

plicable to the theory of the mutual perturbations of Uranus and Neptune. The successive periods of conjunction and opposition, occurring at intervals of eighty-four years, that is, in about the time of revolution of Uranus, this planet is always at the same part of its orbit when it is most affected by the action of Neptune. The action of Neptune, consequently, assumes a fixed, permanent, undisturbed character, so that it can hardly be recognized as perturbation by the practical observer. It is far otherwise with the ordinary class of perturbations, where the place of greatest disturbance varies from point to point of the orbit; thus the place of greatest disturbance in the case of the theoretical planet would not have remained stationary, but have varied 80° upon the orbit of Uranus at each successive conjunction and opposition; so that the disturbance could not in this case be disguised to any great extent under the fixed laws of ordinary elliptic motion. In the case of Neptune, its action on Uranus is to be detected in the comparatively small differences between its character and that of an elliptic motion, and the difference between the influence at opposition and that at conjunction. In undertaking, therefore, anew the solution of the problem of the perturbations of Uranus, with the assumption of the actual period of Neptune, instead of that adopted in the former theories, I found at once that I could not profit by the previous researches of Adams and Leverrier. The problem now presented, instead of being of the usual character, assumed a differential form by the disguise of the primary perturbations under the aspect of elliptic motions, and the whole question now rested upon the secondary perturbations, which were comparatively unimportant in the previous theories.'

"There is a popular notion, which hardly deserves to be refuted before a scientific body, that the less distance of Neptune than the planet of geometry is compensated by its smaller mass, so that its action upon Uranus is the same with that which was predicted. But the fallacy of this view of the subject, which takes no cognizance of the chief difficulty of the problem arising from the unknown orbit of Uranus, is obvious enough from a simple inspection of the following table, in which no one can fail to perceive the difference between the actions of the two planets. The second column of this table, which comprises the action of the theoretical planet of Adams's second hypothesis, is copied from page 27 of Adams's memoir.

Date.	Action upon the longitude of Uranus of		Date.	Action upon the longitude of Uranus of	
	Adams's second hypothetical planet.	Neptune.		Adams's second hypothetical planet.	Neptune.
1845,		$-34''.21$	1797,	$+1''.63$	$-18''.16$
1840,	$-1''.18$	-33.77	1792,	$+1.81$	-19.67
1835,	$-\ .96$	-32.35	1787,	$+1.78$	-22.10
1829,	$-\ .70$	-29.64	1782,	$+1.50$	-25.04
1824,	$-\ .44$	-26.84	1769,	$+\ .21$	-32.25
1819,	$-\ .13$	-23.93	1756,	-1.05	-34.31
1813,	$+\ .35$	-20.72	1715,	$+1.91$	-18.45
1808,	$+\ .83$	-18.81	1690,		-29.47
1803,	$+1.23$	-17.81			

"The difference in the action of the two planets is just balanced by the difference in the corrections of the elements of Uranus in the two theories. The corrections are given in the following table.

From the Theory of	Corrections in the Elements of the Orbit of Uranus of the				
	Mean Annual Motion.	Mean Distance.	Longitude of Epoch.	Eccentricity.	Longitude of Perihelion.
Adams's second hypothetical planet, . .	$-0''.17846$	$+0.000148$	$-\ 47''.62$	$+0.0001954$	$+\ 1010''.5$
Neptune with Peirce's computed mass, . .	-1.13560	$+0.000942$	$+2575.4$	-0.0003626	$+\ 8252.4$
Neptune with Struve's mass, ...	-0.10387	$+0.000086$	$+3511.7$	-0.0005510	$+11171.3$

Mr. Bond communicated an account of his recent observations on the great nebula surrounding θ^1 Orionis; with drawings illustrating its appearance as seen through the Cambridge refractor. Of the resolution of parts of the nebula Mr. Bond expresses himself with confidence. Several new stars are added in the vicinity of the Trapezium, and the connection of the nebulous districts about *C* and ι Orionis with the great nebula conclusively established.

The paper was referred for publication in the Memoirs, as was also a communication from Mr. G. P. Bond, on "Some Methods of Computing the Ratio of the Distances of a Comet from the Earth."

Professor Agassiz made some remarks on the distinctive characters of the family of Cyprinoids or suckers, as distinguished from the Cyprinodons, and illustrated the remarkable difference

between the sexes, which had caused the establishment of a large number of nominal species.

DONATIONS TO THE LIBRARY,

FROM NOVEMBER, 1847, TO MAY, 1848.

Mémoires de la Société Ethnologique de Paris. Tom. I. and II. 1841 - 45. 8vo. From the Ethnological Society.

Bulletins de l'Académie Royale des Sciences de Bruxelles. Tom. XII. 2me partie. Tom. XIII. and XIV. 1re partie. 8vo. Bruxelles, 1845 - 47. From the Brussels Academy.

Mémoires Couronnées et Mémoires de Savants Étrangers, publiés par l'Acad. Roy. des Sciences, etc., de Bruxelles. Tom. XIX., XX., XXI. 4to. 1845 - 46. From the Brussels Academy.

Nouveaux Mémoires de l'Acad. Royale des Sciences, etc., de Bruxelles. Tom. XIX. and XX. 4to. 1845 - 7. From the Brussels Academy.

Annales de l'Observatoire Royal de Bruxelles. Tom. V. 4to. 1846. From the Brussels Academy.

A. Quetelet. Observations de Phénomènes Périodiques. 4to. pamph. Bruxelles, 1846. From the Author.

A. Quetelet. Annuaire de l'Observatoire Royal de Bruxelles. Ann. 13me et 14me. 12mo. pamph. From the Brussels Observatory.

Annuaire de l'Académie Royale des Sciences, etc., de Bruxelles. Ann. 12me et 13me. 12mo. pamph. 1846 - 47. From the Academy.

Francis C. Gray. Prison Discipline in America. 8vo. pamph. Boston, 1847. From the Author.

Abhandlungen der Königlichen Preuss. Akademie der Wissenschaften zu Berlin. Jahr. 1845. 4to. 1847. From the Berlin Academy.

Monatsbericht der Königl. Preuss. Akad. Wissenschaften zu Berlin. Jan. - Dec. 1847. 8vo. From the Berlin Academy.

Flora Batava: Afbeelding en Beschrijzing van Nederlandsche Gewassen, door Jan Kops. Afgebuld on der opzigt van J. C. Sepp en Zoon. Aflev. 144, 145, 146. Amsterdam. From the Author.

Verhandlungen der Kaiserlich-Russischen Mineralogischen Gesellschaft zu St. Petersburg. Jahr. 1845 - 46. 8vo. pamph. 1846. From the Society.

Sir J. F. W. Herschel. Notice of the Life, Researches, and Discoveries of F. W. Bessel. From Rev. R. Sheepshanks.

Sir J. F. W. Herschel. Memoir of Francis Baily. 8vo. pamph. London, 1845. From Rev. R. Sheepshanks.

Portrait of Francis Baily, Esq. London, 1847. From Rev. R. Sheepshanks.

Usher Parsons, M. D. Physician for Ships. 3d ed. Boston, 1842. — Boylston Prize Essays. Boston, 1839. — Directions for making Anatomical Preparations. Philadelphia, 1834. — Remarks on Quarantine Systems. Boston, 1836. — Lecture on the Connection and Reciprocal Influence between the Brain and the Stomach. Providence, 1841. — Spinal Diseases: their Causes and Treatment. Boston, 1843. — 8vo. pamphlets. From the Author.

Frans. Ritter von Hauer. Die Cephalopoden des Salzkammergutes, aus der Sammlung seiner Durchlaucht des Fürsten von Metternich, etc. 4to. Vienna, 1846. From Prince Metternich.

J. D. Dana. On Certain Laws of Cohesive Attraction, as exemplified in a Crystal of Snow. 8vo. pamph. (Extr. from Amer. Jour. Sci.) From the Author.

Twenty-seventh Annual Report of the Mercantile Library Association of New York. New York, Jan. 1848. 8vo. From the Directors.

A. D. Bache. Report of Alexander D. Bache, Superintendent of the Coast Survey, showing the Progress of that Work for the Year ending October, 1847. From the Author.

Transactions of the American Philosophical Society. Vol. X., Part I. Philadelphia, 1847. From the Society.

Prof. Hausmann. Studien des Göttingischen Vereins Bergmannischer Freunde. 1833 - 44. 6 vols. 12mo. From the Author.

Geo. P. Marshall. Occultations Visible in the United States during 1848. Philadelphia, 1848. From the Author.

Magnetical and Meteorological Observations at St. Helena, during 1840, 1841, 1842, and 1843. Vol. I. 4to. London, 1847. From the British Government.

Prof. Silliman. American Journal of Science and Arts, for Jan., March, and May, 1848. From the Editors.

F. A. W. Miguel. Illustrationes Piperacearum. Rotterdam, 1844. From. Acad. Nat. Cur. Bonn and Breslau.

Abhandlungen der Phil.-Philol. Classe der Königl. Bayerschen Akad. der Wissenschaften. Band. III. and IV., Abth. 1, 2. 1840 - 46. — Historisch. Classe. Band. III. and IV., Abth. 1, 2. 1841 - 45. — 4to. Munich. From the Royal Bavarian Academy.

Gelehrte Anzeigen. (Bayersch. Akad.) Bände VI. - XXI. Munich, 1838 - 45. From the Royal Bavarian Academy.

Annual Report of the Trustees of the State Library, New York, 1848. 8vo. Albany. From the Trustees.

Bulletin de la Société Impériale des Naturalistes de Moscou. No. III. 8vo. Moscow, 1846. From the Society.

G. Fischer de Waldheim. Spicilegium Entomographiæ Rossicæ. (Extr. Bull. Imp. Soc. Natur. Mosc. 1844.) From the Author.

G. Fischer de Waldheim. Entomographie de la Russie. IV[me] Vol. (Orthoptères). 4to. Moscow, 1846. From the Author.

G. Fischer de Waldheim. Notice sur quelques Sauriens Fossiles de Moscou. 4to. pamph. From the Author.

La Lega Italiana, Giornale Pol. Econ. Scien. e Litterario. Nos. 1 - 4. Genoa. From the Editor.

Map of the Mineral Lands adjacent to Lake Superior, ceded to the United States by the Treaty of 1842 with the Chippewas. From the War Department.

Joseph Leidy, M. D. Researches into the Comparative Structure of the Liver (with 3 plates). — On some Bodies in the Boa Constrictor resembling the Pacinian Corpuscules. — On a New Genus and Species of Fossil Ruminantia. — On a New Fossil Genus and Species of Ruminantoid Pachydermata. — 8vo. pamphlets. From the Author.

Ἀριστόβουλος. Universal Destruction of Aboriginal Races by Colonizing Nations, and eventually of the New Zealanders. London, 1847. pamph. From the Author.

Philosophical Transactions of the Royal Society of London for the year 1847. (Parts 1 and 2.) London, 1847. From the Royal Society.

Greenwich Astronomical Observations for 1845. London, 1847. From the Royal Society.

Prof. Loomis. Astronomical Observations at Hudson Observatory, Ohio. 3d Series. (Extr. from Trans. Amer. Phil. Soc., Vol. X.) From the Author.

Proceedings of the Academy of Natural Sciences. Philadelphia. Vol. III., 1846 - 47, and Vol. IV. to April, 1848. From the Academy.

Proceedings of the American Philosophical Society at Philadelphia. Vol. IV., for 1847. 8vo. From the Society.

Transactions of the Linnæan Society of London. Vol. XX., Part 2. 4to. — Proceedings of the Linnæan Society, Nos. 30 - 33. (1846 - 47.) 8vo. — From the Society.

Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen. Bände I. – III. (1843 – 47). 4to. From the Society.

Nachrichten von der Geog.-August. Universitat. und der Königl. Gesellschaft zu Göttingen. From the Royal Society of Göttingen.

Prof. Hausmann. Bemerkungen über Gyps und Karstenit. 4to. pamph. (Extr. Mem. Götting., Vol. III.) Göttingen, 1847.

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Tom. XI. (1846 – 48.) 4to. Geneva. From the Society.

END OF VOLUME I.